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PROVISIONAL SPECIFICATION

Invention Title: **METHOD AND APPARATUS FOR PROCESSING FLUIDS**

The invention is described in the following statement:

METHOD AND APPARATUS FOR PROCESSING FLUIDS

FIELD OF INVENTION

The present invention relates generally to the processing of fluids and/or their carriers. Carriers include pipes, tubes and the like or reservoirs for the distribution and/or storage of fluids. In particular, the present invention relates to a method and apparatus that is suitable for use in the treatment of water by introducing chemically active metal, for example, antimicrobial forms of metal into the water and its carriers for disinfection of the water in a controlled manner, and it will be convenient to hereinafter describe the invention in relation to that application. It should be appreciated, however, that the present invention is not limited to that application, only. Notably, the present invention is suitable for use in the processing of other fluids, for example, milk, starches, syrups, fruit juices, biological fluids from animals or humans, liquid fossil fuels and the like. In one particular aspect, the present invention is also suitable for use as a method and means for fluid flow recognition or determination.

BACKGROUND OF INVENTION

In the context of the present invention, it is to be taken that the term "fluid" applies to any material that displays liquid-like or gas-like behaviour or physical properties.

The treatment of fluids by disinfection, for example, is an important process enabling the safe and efficient use and/or consumption of these fluids in industrial and domestic environments. For example, the ability to disinfect water for general consumption by animals and/or humans including drinking and recreational use is paramount. An example application of such treated water includes production liquid for the preservation of fresh cut flowers. When treating fluids it is also critical that the flow of the given fluid is determined and/or controlled.

Prior art techniques used for disinfecting fluids, such as for example in Australian Patent 53032/98 (735166), Australian Patent 11859/97 (702918) and Australian Patent 24394/95 (685630), make use of the ability of silver ions to effectively destroy micro-organisms such as bacteria and viruses. However, in these prior art systems, the silver that is being introduced into a given fluid requires sophisticated electronic equipment for either monitoring the amount or

dose of silver being introduced or monitoring the volumetric flow of fluid to be treated. Moreover, regulatory authorities throughout the world now stipulate their own varying individual maximum levels of silver that may be added to fluids for their treatment. These various regulations make it difficult and expensive to control the amount of silver to be released into a given flow of fluid.

Other prior art systems, such as disclosed in DE 4107708, attempt to accurately monitor fluid flow. These systems require the use of delicate on/off flow switches and are therefore, expensive. Generally, the flow switches of prior art systems are made using glass encased reed switches and magnets of differing types. Reed switches, in particular, are easily cracked and as a result may fail to perform. Furthermore, the circuits required to control these systems often fail especially where corrosion occurs as would be expected when placed in close proximity or contact with the various fluids being treated. In the event of these failures, the prior art systems cannot provide for regulated introduction of silver into a fluid.

Prior art silver disinfection systems may also have a tendency to cause an overdose of silver into the fluid. Notwithstanding the toxic effects of excessive silver consumption, a further problem associated with silver overdosing has been shown, namely, de-oxygenation. When excessive amounts of silver are introduced into a body of fluid the excess silver will absorb the available free oxygen and may use the absorbed oxygen to destroy anaerobic micro-organisms by the process of oxidation leaving the fluid in a de-oxygenated form. The de-oxygenated fluid then becomes an environment that is conducive to the multiplication and resultant re-infection of micro-organisms. This re-infection is also assisted by the fact that dissolved silver will, in a relatively short time, plate out to the walls containing the fluid or, being heavy will fall out of suspension removing the active silver from the fluid. Thus, there is a need to maintain a correct balance of silver concentration for successful disinfection.

Prior art systems such as that disclosed in Australian Patent 53032/98 (735166) have provided a solution to the problem of plating by producing suspended silver particles instead of silver ions. Such particles are not soluble and cannot plate out and, in turn, as the particles are of pure silver and not silver ions forming silver salts, they may not produce toxic effects in high doses.

However, complex circuits are required to produce pure silver particles and this is a disadvantage, particularly when a readily useful and easily accessible means of disinfection is required in the market. Furthermore, the lack of plating displayed by silver particles is a disadvantage when it is desirable to treat the surface or walls of a fluid carrier to produce, for example, a bacteriostatic coating of silver preventing biofilm build up.

It is therefore an object of the present invention to provide a method and apparatus, which ameliorates at least one or more disadvantage of the prior art arrangements. It is also an object of the present invention to provide a method and apparatus providing for the control or monitoring of the introduction of chemically active forms of metal into a fluid that may flow at a variable rate. It is also an object of the present invention to provide a method and apparatus for providing control over the plating out effect of an introduced metal on the walls of a fluid carrier.

Any discussion of documents, devices, acts or knowledge in this specification is included to explain the context of the invention. It should not be taken as an admission that any of the material formed part of the prior art base or the common general knowledge in the relevant art in Australia on or before the priority date of the claims herein.

SUMMARY OF INVENTION

In one aspect the present invention provides apparatus for processing fluid including: a body defining a fluid flow passage having a fluid inlet and a fluid outlet, the body including a first electrode arrangement and a second electrode arrangement displaceable with respect to the first electrode arrangement, the first and second electrode arrangements adapted for connection to a supply of electric current such that fluid within the body forms part of an electrolytic cell providing for a flow of ions between the first and second electrode arrangements; biasing means operatively associated with the second electrode arrangement and adapted to displace the second electrode arrangement against a flow of fluid within the body in order to displace the second electrode arrangement into closer proximity with the first electrode arrangement as the fluid flow rate increases, thereby increasing the flow of ions, and to displace the second electrode

arrangement away from the first electrode arrangement as the fluid flow rate decreases, thereby decreasing the flow of ions.

In another aspect, the present invention provides a method of processing a fluid including the steps of: providing a body defining a fluid flow passage having a fluid inlet and a fluid outlet, the body including a first electrode arrangement and a second electrode arrangement displaceable with respect to the first electrode arrangement, the first and second electrode arrangements adapted for connection to a supply of electric current such that fluid within the body forms part of an electrolytic cell providing for a flow of ions between the first and second electrode arrangements; providing an electric current supply from an electric circuit to the first and second electrode arrangements; passing the fluid through the body such that the displacement of the second electrode arrangement is biased against a flow of fluid within the body in order to displace the second electrode arrangement into closer proximity with the first electrode arrangement as the fluid flow rate increases, thereby increasing the flow of ions, and to displace the second electrode arrangement away from the first electrode arrangement as the fluid flow rate decreases, thereby decreasing the flow of ions.

In a further aspect, the present invention provides a method of determining fluid flow including the steps of: providing a body defining a fluid flow passage having a fluid inlet and a fluid outlet, the body including a first electrode arrangement and a second electrode arrangement displaceable with respect to the first electrode arrangement, the first and second electrode arrangements adapted for connection to a supply of electric current such that fluid within the body forms part of an electrolytic cell providing for a flow of ions between the first and second electrode arrangements; providing an electric current supply from an electric circuit to the first and second electrode arrangements; passing the fluid through the body such that the displacement of the second electrode arrangement is biased against a flow of fluid within the body in order to displace the second electrode arrangement into closer proximity with the first electrode arrangement as the fluid flow rate increases, thereby increasing the flow of ions, and to displace the second electrode arrangement away from the first electrode arrangement as the fluid flow rate decreases, thereby decreasing the flow of ions; determining the fluid flow rate by measuring either one or both of: an ion current

density between the first and second electrode arrangements, and; a relative displacement of the first and second electrode arrangements.

In essence, the present invention stems from the realisation that transducing or converting fluid flow to a biased displacement of at least one electrode arrangement of an electrolytic cell provides a flow of ions, or an ion current density, within the fluid and between electrode arrangements, which corresponds to and is therefore regulated by the flow rate of the fluid. This biased displacement of an electrode arrangement allows for the introduction of ions into a fluid at a controlled or easily monitored rate that is commensurate with the amount of fluid flow. It also follows that, correspondingly, a measurement of the relative displacement of the first and second electrode arrangements and/or the ion current density or rate of ion introduction into the fluid provides a corresponding determination of the fluid flow rate itself. Within an electrolytic cell, forming part of the apparatus in accordance with one embodiment of the present invention, an electric current supplied to the first and second electrode arrangements will flow in a completed electric circuit and provide a flow of ions within the fluid and between the first and second electrode arrangements that increases with increasing fluid flow rate as the second electrode arrangement moves into closer proximity to the first electrode arrangement and decreases with decreasing fluid flow rate as the second electrode arrangement moves away from the first electrode arrangement.

In preferred embodiments of the method and apparatus for processing a fluid according to the present invention, the rate of introduction of ions into a fluid may be such that the ion flow or ion current density within the processed fluid is regulated in a directly proportional relationship to the fluid flow rate. Further to this, in preferred embodiments, the present invention may provide a directly proportional relationship between the displacement of the electrode arrangements and the fluid flow rate.

In accordance with a preferred embodiment, the first electrode arrangement includes an electrode fixed relative to the body and the second electrode arrangement includes two opposed electrodes, mounted within a moveable support, allowing for positioning of the fixed electrode therebetween

and wherein, the biasing means includes a spring connected to the body means. The moveable support may be a piston arrangement including a sliding piston.

The ions produced by the fluid processing apparatus may be metal ions emanating from the electrode arrangements during electrolysis and having anti-microbial and plating out properties such that the metal ions plate to fluid contact surfaces of the body. Furthermore, these ions may plate to contact surfaces of a fluid carrier means located or connected beyond the body to form a biostatic film on a number of fluid contact surfaces.

At least one of the electrode arrangements may include silver for producing a flow of silver ions between the electrodes. Any suitable electric circuit may be used for supplying electric current to the electrolytic cell formed within the apparatus in accordance with preferred embodiments of the invention.

In one preferred embodiment, the apparatus of the present invention may further include: fluid flow measurement means for determining whether there is actual fluid flow between the inlet and the outlet of the body, and; an electric circuit for supplying electric current to the electrolytic cell may include circuit control means for reducing the electric current supplied to the first and second electrode arrangements if there is no actual fluid flow determined by the fluid flow measurement means. The fluid flow measurement means may include a flow switch having a magnet and a reed switch.

The electric circuit may be arranged to include circuitry for activating a standby mode including: an operational amplifier circuit in a current return path of the electric circuit adapted to detect a no fluid flow current threshold level selected to be nominally greater than a galvanic current drawn by the electrolytic cell when there is no fluid flow in the body, the operational amplifier circuit may be further adapted to output a signal indicating a no fluid flow condition upon detecting the no fluid flow current threshold level. The circuit may also include a micro-controller adapted to receive output signals of the operational amplifier and, upon receiving an output signal indicating the no fluid flow condition, increment a timer within the micro-controller for a predetermined continuous period of time at the end of which, if the no fluid flow condition remains, the micro-controller is further adapted to activate the standby mode by activating circuit shunt means within the electric circuit to reduce the electric current supplied to the first and

second electrode arrangements. It is also possible for the electric circuit to further include circuitry for activating an operating mode including: the operational amplifier circuit adapted to detect a fluid flow current threshold level selected to be nominally greater than the no fluid flow current threshold level. The operational amplifier circuit may be further adapted to output a signal indicating a fluid flow condition upon detecting the fluid flow current threshold level. Sampling means may be included for periodically sampling the output of the operational amplifier circuit at the micro-controller during the standby mode. Circuit means may be included for increasing an electric current supply to the first and second electrode arrangements in response to the micro-controller receiving a sampled output signal from the operational amplifier circuit indicating the fluid flow condition.

In one preferred embodiment, the method of processing a fluid according to the present invention includes activating the standby mode including the steps of: determining a no fluid flow condition by adapting an operational amplifier circuit in a current return path of the electric circuit to detect a no fluid flow current threshold level selected to be nominally greater than a galvanic current drawn by the electrolytic cell when there is no fluid flow in the body; providing an output signal of the operational amplifier circuit to a micro-controller; upon receiving an output signal of the operational amplifier circuit indicating the no fluid flow condition, incrementing a timer within the micro-controller for a predetermined continuous period of time at the end of which, if the no fluid flow condition remains, the micro-controller activates the standby mode by activating a circuit shunt means within the electric circuit to reduce the electric current supplied to the first and second electrode arrangements.

It is also preferable for the method of processing a fluid to include activating the operating mode in accordance with the steps of: determining a fluid flow condition by adapting the operational amplifier circuit to detect a fluid flow current threshold level selected to be nominally greater than the no fluid flow current threshold; periodically sampling the output of the operational amplifier circuit at the micro-controller during the standby mode; upon receiving an output signal of the operational amplifier circuit indicating the fluid flow condition, the

micro-controller deactivates the circuit shunt means to resume the electric current supplied to the first and second electrode arrangements.

In an embodiment of the method of determining fluid flow in accordance with the present invention, the step of providing an electric current supply includes supplying an electric current regulated by a micro-controller within the electric circuit and, the step of measuring an ion current density includes detecting a current sense signal, corresponding to the ion current density, in a current return path of the micro-controller within the electric circuit.

In accordance with a further embodiment of the present invention the method of determining fluid flow may include the step of activating a standby mode including the steps of: determining a no fluid flow condition by adapting an operational amplifier circuit in the current return path of the micro-controller to detect a no fluid flow current threshold level selected to be nominally greater than the galvanic current drawn by the electrolytic cell when there is no fluid flow in the body; providing an output signal of the operational amplifier circuit to the micro-controller; upon receiving an output signal of the operational amplifier circuit indicating the no fluid flow condition, incrementing a timer within the micro-controller for a predetermined continuous period of time at the end of which, if the no fluid flow condition remains, the micro-controller activates the standby mode by activating circuit shunt means to reduce the electric current supplied to the first and second electrode arrangements. The method of determining fluid flow may also include activating an operating mode including the steps of: determining a fluid flow condition by adapting the operational amplifier circuit to detect a fluid flow current threshold level selected to be nominally greater than the no fluid flow current threshold; periodically sampling the output of the operational amplifier circuit at the micro-controller during the standby mode; upon receiving an output signal of the operational amplifier circuit indicating the fluid flow condition, the micro-controller deactivates the circuit shunt means to resume the electric current supplied to the first and second electrode arrangements.

The fluid processing apparatus may further include fluid flow determination means including an ion current measurement arrangement for measuring the ion current density between the first and second electrode arrangements where the ion current density corresponds to the fluid flow rate. Alternatively, a

measurement of the relative displacement of the first and second electrode arrangements may provide a determination of the relative fluid flow rate. In further embodiments the fluid processing apparatus may be calibrated such that the relative displacement of the first and second electrode arrangements provides a determination of the absolute volumetric fluid flow rate.

Either analogue or digital circuit means may be utilised for reducing the electric current supplied to the first and second electrode means if there is no actual fluid flow determined by the fluid flow measurement means. Moreover, as a preferred alternative to the use of flow switch means for measuring actual fluid flow to activate and deactivate the processing apparatus, the electric circuit means in accordance with preferred embodiments of the present invention may include circuitry for activating the standby mode and operating mode as mentioned above.

A display may be provided to indicate the activation of the standby mode and/or the activation of the operating mode.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of one or more preferred embodiments of the present invention will be readily apparent to one of ordinary skill in the art from the following written description with reference to and, used in conjunction with, the accompanying drawings, in which:

Figure 1 is a diagrammatic sectional side elevation of a fluid processing apparatus according to a preferred embodiment of the present invention and suitable for use in performing the method of the present invention;

Figure 2 is a circuit diagram illustrating, in part, an electric circuit according to a preferred embodiment of the present invention..

DESCRIPTION OF PREFERRED EMBODIMENT

An exemplary embodiment of the present invention resides in its use for the processing of a fluid by means of silver ion disinfection for the disinfection of a flowing fluid in conjunction with making use of the benefit of the plating out properties of silver ions to the surface of a fluid carrier including, for example, a body in the form of a chamber for fluid flow.

Referring to Figure 1, a fluid processing unit is shown generally as 1. The fluid processing unit 1 may be an ion disinfection apparatus or equally, a fluid flow

determination apparatus and is defined by a body having a chamber 2 formed with a spaced inlet 3 and an outlet 4 respectively at opposite ends of the chamber 2. The outlet 4, or possibly more than one outlet, may be situated so as to breach the wall of chamber 2 whereby the fluid may be caused to flow from inlet 3 to outlet 4. Within the unit 1 shown in Figure 1, the first electrode arrangement includes a single silver electrode 6 and the second electrode arrangement includes two silver joined electrodes 5. The joined electrodes 5 are mounted moveably adjacent the inlet opening 3. The assembly of joined electrodes 5 is biased by a light stainless steel tension spring 7, operatively associated with a housing or support 11 for the electrodes 5 to occupy a position in which the assembly retracts from an electrolysing position to a position remote from electrode 6 when the flow of fluid ceases. Assembly 5 is adapted to be moved against the action of the spring 7 by incoming fluid so that the fluid will enter and pass through the chamber 2. As illustrated, the parts are made and arranged such that movement or displacement of the electrode assembly 5 against the action of the spring 7 will cause a normally greater distance between electrode assembly 5 and electrode 6, which is in a normally fixed position, to decrease. It would be recognised by the person skilled in the art that the portion of the chamber 2 including the electrode assembly 5, stationary electrode 6 and the fluid therebetween forms an electrolytic cell.

The circuit 20 of Figure 2 will detect an increase in electron flow as the distance between electrode assembly 5 and electrode 6 decreases and once the electron flow exceeds preferably 2 milliamps, the circuit 20 of figure 2 will switch on an electrical energy supply to pass between electrode assembly 5 and electrode 6. As the electrode assembly 5 moves or is displaced toward electrode 6 an increase of current is applied to the electrodes due to the reduced resistance between the electrodes of 5 and 6 at a given potential difference. This in turn translates to a greater silver ion production or ion current density increasing in concentration as the increase in flow of the fluid causes moveable electrode assembly 5 to lessen the distance between electrode arrangements 5 and 6. As the fluid flow decreases, the distance between the electrodes of assembly 5 and electrode 6 becomes greater lessening the amount of silver production from the electrodes and corresponding to a decreased ion current density. The electrical

supply to the aforementioned moveable electrodes 5 may be connected to a spring anchor 8 via electrode lead 10. The electrical supply may correspondingly also be connected to electrode 6 directly from electrode lead 9. It would be recognised by the person skilled in the art that measurement of the ion current density between electrodes 5 and 6 provides a corresponding measurement of the fluid flow rate under these conditions.

Electrode assembly housing or support 11 is substantially cylindrical and provided with guided displacement means and having a clearance within chamber 2. The aforementioned light tension spring 7 may be anchored by anchor 8 which is of non-electrolysing but conductive metal element, preferably, grade 316 stainless steel. Once fluid enters chamber 2 via inlet 3 and tension is applied to spring 7 an electrical contact is made via spring 7 from anchor 8 to electrodes in electrode assembly 5. A standby pulse as described in more detail below from the circuit 20 of Figure 2 may check for any ion current flow between electrodes of assembly 5 and electrode 6 preferably every two to five seconds. Once a current flow of preferably 2 milliamps is present, then the circuit 20 of Figure 2 applies a current flow between the electrodes 5 and 6. When electrode assembly 5 is at a normally standby position (without a flow of fluid) the current flow between electrodes 5 and 6 will be less than 2 milliamps and the circuit 20 of Figure 2 will prevent any current from flowing between said electrodes by acting as a gate. At this stage of operation, the circuit 20 of Figure 2 may commence a test pulse preferably every two to five seconds to monitor the activity of the apparatus.

The method of operation of the apparatus and the apparatus itself including the normal operating and standby mode is now described in further detail in accordance with a preferred embodiment of the invention, which provides a method and apparatus for silver ion disinfection of water with reference to the accompanying drawings. The water disinfection apparatus of Figure 1 provides a body or chamber 2 defining a fluid flow passage formed between inlet 3 and outlet 4. A minimum of one electrode 6 is mounted stationary with respect to the chamber 2 for the flow of water to pass over it in its passage from the inlet opening 3 to the outlet opening 4. A minimum of one and preferably two electrodes 5 are mounted to or supported by a displaceable or moveable housing,

preferably a sliding piston 11, arranged so that its outer end has the electrodes 5 exposed. One or all of the electrodes 5, 6 are preferably made of silver. The sliding piston 11 with the exposed electrodes 5 may be arranged such that as the water enters the chamber 2 the piston 11 moves the two exposed electrodes 5 towards and in close proximity to the aforementioned stationary electrode 6. A power cell or supply of DC current having terminals denoted as T1 and T2 in Figure 2, is connected via the circuit 20 of Figure 2, to the electrodes 5, 6 for the production of silver ions via electrolysis. The circuit 20 of Figure 2 is coupled to the electrodes 5, 6 and may act as a gate to prevent current leakages of less than around 2 milliamps from activating the production of silver ions. The same circuit 20 makes a current above around 2 milliamps available to the electrodes 5, 6 and may incorporate a reversing polarity for the cleaning of the electrodes 5, 6.

As the piston 11 holding the two electrodes 5 is moved towards the fixed or stationary electrode 6 a current draw above 2 milliamps is created allowing the activation of electrolysis hence producing silver ions. The closer the piston 11 is moved toward the fixed electrode 6 by the greater flow of water, the greater the current draw and hence, the greater amount of silver ions produced. As the piston 11 holding the two electrodes 5, which may be fixed to a stainless steel spring 7, retracts due to the loss of water flow then the current draw is less and thus produces a lesser amount of silver ions. Any other desired circuit for the production of metal particles other than silver and, which have anti microbial properties or other bioactive propeties, may be fitted after the aforementioned controllable gate circuit 20.

As with prior art and, should it be found necessary, the present invention may also involve electrolysis being activated or deactivated using a magnet and reed switch. The activation and/or deactivation of electrolysis may be provided by any suitable flow switch that is available in the market place such as those including a magnet and reed switch.

In a preferred embodiment of the present invention when a flow switch is not used to activate or deactivate electrolysis, the electronic circuit 20 of Figure 2 may be utilised to determine water flow activity. This feature of the present invention allows for fully automatic operation under micro-control. The amount of silver electrolysed into the water is a function of both the current density of the

water and the water flow rate. The current density regulating method of the present invention is able to accurately maintain the correct levels of electrolysed silver in the water to be treated under varying flow rates and conditions and, in accordance with a preferred embodiment, is able to activate or deactivate the electrolysing process under no flow conditions. Not pertaining to reed switches or other flow switches the operation of the circuit 20 that provides an alternative to the activation and deactivation of electrolysis for the present invention is described as follows with reference to Figure 2:

The circuit 20, acting as a gate, is supplied with regulated DC voltage across power supply input terminals T1 and T2. Circuit element D1 provides reverse polarity protection for the circuit 20 and capacitor C1 provides filtering from noise and transients. Integrated circuit U3 and capacitor C2 provide the microprocessor U1 with a regulated 5V DC supply source. Variable resistor R1 provides an adjustable voltage input to the positive input of operational amplifier U2-A. Operation amplifier U2-A is configured as a unity gain buffer with transistor Q2 inside of the feedback loop. Capacitor C3 provides a power supply bypass for operational amplifier U2-A and capacitor C4 provides a bypass for the collector transistor Q2. Transistor Q2 is configured as voltage follower and provides the necessary positive current to electrolyse the silver through terminal T3 via blocking diode D4.

Resistor R5 provides a resistive load to the emitter of Q2 to ensure the circuit will perform properly regardless of whether there is a load present or not at T3. Blocking diode D4 ensures that any galvanic voltage created by the water processing unit 1 does not result in any substantial current flow through the unit 1. Without the blocking diode D4 the internally generated galvanic voltage of the unit 1 will continue to electrolyse the silver into the water, potentially above safe levels during long periods of no water flow.

The current return path of circuit 20 consists of terminal T4 and current shunt resistor R6 the other end of which is connected to circuit ground. Capacitor C5 provides filtering for any high frequency AC noise components. Operational amplifier U2-B is configured as a non-inverting variable gain amplifier.. The feed back loop includes resistors R9, R8 and R7. Resistor R8 is a potentiometer and enables the circuit 20 and thus the water processing unit 1 overall to be calibrated

for the selected operating set point. The amplified current sense voltage is filtered by the RC low pass filter network consisting of R10 and C6 and is applied to an analogue to digital converter input of the microprocessor U1 at pin 7 thereof, as illustrated in Figure 2. The circuit 20 is calibrated by adjusting R1 to give the desired current flow at the maximum water flow rate. The current threshold level is calibrated with resistor R8. The current threshold value is selected to be nominally higher than the current drawn by the unit 1 in the no fluid flow condition. Under normal operating conditions the circuit 20 applies the full current source voltage to the unit 1 and the current is modulated relative to the rate of water flow through the unit 1 by means of the water flow rate modulating the relative displacement of the electrodes, as has been previously described. When the water flow through the unit 1 is terminated the current will fall below the low current threshold programmed into microprocessor U1 which then increments an internal timer as long as the current is below the low current threshold. The micro processor U1 continually checks the amount of time that the current has been below the low current threshold and when the predetermined amount of time has been accumulated activates transistor Q1 which effectively shunts the output of voltage divider resistor R1 to ground effectively reducing the current flowing through the unit 1 to zero to effect a standby mode. The timer measures a continuous time period of current being below the predetermined threshold value to activate the standby mode and will reset the timer to zero should normal system current levels be detected before the predetermined below threshold or low current time is accumulated. While the unit 1 is in the standby mode controllable circuit 20 samples the unit 1 for fifty milliseconds every five seconds to sense if the current has again increased indicating that water flow through the unit 1 has been resumed. The threshold to indicate the unit 1 is again in active use or normal operating mode is purposely made higher by a small amount to provide some hysteresis in the function of the device to ensure that it does not reach a threshold condition where it would toggle continually between the two operating states. The sampling method results in a duty cycle of one percent, which would allow for normal periods of non use with complete confidence that the silver levels in the water would not rise above generally accepted or regulated safe levels. The controllable circuit 20 is equipped with red LED D2 powered

through current limiting resistor R3 from the microprocessor U1 and a green LED D3 powered through current limiting resistor R4 from the microprocessor U1 to provide a visual indication to the user of whether the unit is in the standby or operating mode.

As the present invention may be embodied in several forms without departing from the spirit of the essential characteristics of the invention, it should be understood that the above described embodiments are not to limit the present invention unless otherwise specified, but rather should be construed broadly within the spirit and scope of the present invention as defined in the appended claims. Various modifications and equivalent arrangements are intended to be included within the spirit and scope of the present invention and appended claims. For example, the body defining the fluid flow passage within the apparatus of the present invention is described in one embodiment herein as a chamber. Equally, the body may be an open channel defining a fluid flow passage. Such variations to the body may be more suitable than a closed channel arrangement depending on, for instance, the fluid being processed. As a further example, the biasing means should not necessarily be restricted to a coil spring as described in one embodiment herein. It would be recognised by the person skilled in the art that other biasing means provide the equivalent function and may be used as a substitute.

"Comprises/comprising" when used in this specification is taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof."

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. Apparatus for processing fluid including:

a body defining a fluid flow passage having a fluid inlet and a fluid outlet, the body including a first electrode arrangement and a second electrode arrangement displaceable with respect to the first electrode arrangement, the first and second electrode arrangements adapted for connection to a supply of electric current such that fluid within the body forms part of an electrolytic cell providing for a flow of ions between the first and second electrode arrangements;

biasing means operatively associated with the second electrode arrangement and adapted to displace the second electrode arrangement against a flow of fluid within the body in order to displace the second electrode arrangement into closer proximity with the first electrode arrangement as the fluid flow rate increases, thereby increasing the flow of ions, and to displace the second electrode arrangement away from the first electrode arrangement as the fluid flow rate decreases, thereby decreasing the flow of ions.

2. Apparatus as claimed in claim 1, wherein the first electrode arrangement includes an electrode fixed relative to the body and the second electrode arrangement includes two opposed electrodes, mounted within a moveable support, allowing for positioning of the fixed electrode therebetween.

3. Apparatus as claimed in claim 1 or 2 wherein, the biasing means includes a spring connected to the body means.

4. Apparatus as claimed in claim 1, 2 or 3, wherein the ions are metal ions having anti-microbial and plating out properties such that the metal ions plate to fluid contact surfaces of the body and fluid carrier means located beyond the body to form a biostatic film on the fluid contact surfaces.

5. Apparatus as claimed in claim 2, 3 or 4, wherein the moveable support includes a piston and at least one of the electrode arrangements includes silver for producing a flow of silver ions between the electrodes.

6. Apparatus as claimed in any one of claims 1 to 5 further including an electric circuit for supplying electric current to the electrolytic cell.

7. Apparatus as claimed in claim 6 further including:

fluid flow measurement means for determining whether there is actual fluid flow between the inlet and the outlet of the body, and wherein;

the electric circuit for supplying electric current to the electrolytic cell includes circuit control means for reducing the electric current supplied to the first and second electrode arrangements if there is no actual fluid flow determined by the fluid flow measurement means.

8. Apparatus as claimed in claim 7, wherein the fluid flow measurement means includes a flow switch having a magnet and a reed switch.

9. Apparatus as claimed in claim 6, wherein the electric circuit includes circuitry for activating a standby mode including:

an operational amplifier circuit in a current return path of the electric circuit adapted to detect a no fluid flow current threshold level selected to be nominally greater than a galvanic current drawn by the electrolytic cell when there is no fluid flow in the body, the operational amplifier circuit further adapted to output a signal indicating a no fluid flow condition upon detecting the no fluid flow current threshold level;

a micro-controller adapted to receive output signals of the operational amplifier and, upon receiving an output signal indicating the no fluid flow condition, increment a timer within the micro-controller for a predetermined continuous period of time at the end of which, if the no fluid flow condition remains, the micro-controller is further adapted to activate the standby mode by activating a circuit shunt means within the electric circuit to reduce the electric current supplied to the first and second electrode arrangements.

10. Apparatus as claimed in claim 9, wherein the electric circuit further includes circuitry for activating an operating mode including:

the operational amplifier circuit adapted to detect a fluid flow current threshold level selected to be nominally greater than the no fluid flow current

threshold level, the operational amplifier circuit further adapted to output a signal indicating a fluid flow condition upon detecting the fluid flow current threshold level;

sampling means for periodically sampling the output of the operational amplifier circuit at the micro-controller during the standby mode;

circuit means for increasing an electric current supply to the first and second electrode arrangements in response to the micro-controller receiving a sampled output signal from the operational amplifier circuit indicating the fluid flow condition.

11. A method of processing a fluid including the steps of:

providing a body defining a fluid flow passage having a fluid inlet and a fluid outlet, the body including a first electrode arrangement and a second electrode arrangement displaceable with respect to the first electrode arrangement, the first and second electrode arrangements adapted for connection to a supply of electric current such that fluid within the body forms part of an electrolytic cell providing for a flow of ions between the first and second electrode arrangements;

providing an electric current supply from an electric circuit to the first and second electrode arrangements;

passing the fluid through the body such that the displacement of the second electrode arrangement is biased against the flow of fluid within the body in order to displace the second electrode arrangement into closer proximity with the first electrode arrangement as the fluid flow rate increases, thereby increasing the flow of ions, and to displace the second electrode arrangement away from the first electrode arrangement as the fluid flow rate decreases, thereby decreasing the flow of ions.

12. A method as claimed in claim 11 further including the steps of:

determining whether there is actual fluid flow between the inlet and the outlet of the body, and;

reducing the electric current supplied to the first and second electrode arrangements if there is no actual fluid flow determined in the actual fluid flow determining step.

13. A method as claimed in claim 12, wherein the actual fluid flow determining step includes the use of a flow switch and wherein the flow switch includes a magnet and a reed switch.

14. A method as claimed in claim 11, further including activating a standby mode including the steps of:

determining a no fluid flow condition by adapting an operational amplifier circuit in a current return path of the electric circuit to detect a no fluid flow current threshold level selected to be nominally greater than a galvanic current drawn by the electrolytic cell when there is no fluid flow in the body;

providing an output signal of the operational amplifier circuit to a micro-controller;

upon receiving an output signal of the operational amplifier circuit indicating the no fluid flow condition, incrementing a timer within the micro-controller for a predetermined continuous period of time at the end of which, if the no fluid flow condition remains, the micro-controller activates the standby mode by activating a circuit shunt means within the electric circuit to reduce the electric current supplied to the first and second electrode arrangements.

15. A method as claimed in claim 14, further including activating an operating mode including the steps of:

determining a fluid flow condition by adapting the operational amplifier circuit to detect a fluid flow current threshold level selected to be nominally greater than the no fluid flow current threshold;

periodically sampling the output of the operational amplifier circuit at the micro-controller during the standby mode;

upon receiving an output signal of the operational amplifier circuit indicating the fluid flow condition, the micro-controller deactivates the circuit shunt

means to resume the electric current supplied to the first and second electrode arrangements.

16. A method as claimed in any one of claims 11 to 15, wherein the ions are metal ions having anti-microbial and plating out properties such that the metal ions plate to fluid contact surfaces of the body and fluid carrier means located beyond the body to form a biostatic film on the fluid contact surfaces.

17. A method as claimed in any one of claims 11 to 16, wherein at least one of the first and second electrode arrangements includes silver for producing a flow of silver ions between the first and second electrode arrangements.

18. A method of determining fluid flow including the steps of:

providing a body defining a fluid flow passage having a fluid inlet and a fluid outlet, the body including a first electrode arrangement and a second electrode arrangement displaceable with respect to the first electrode arrangement, the first and second electrode arrangements adapted for connection to a supply of electric current such that fluid within the body forms part of an electrolytic cell providing for a flow of ions between the first and second electrode arrangements;

providing an electric current supply from an electric circuit to the first and second electrode arrangements;

passing the fluid through the body such that the displacement of the second electrode arrangement is biased against a flow of fluid within the body in order to displace the second electrode arrangement into closer proximity with the first electrode arrangement as the fluid flow rate increases, thereby increasing the flow of ions, and to displace the second electrode arrangement away from the first electrode arrangement as the fluid flow rate decreases, thereby decreasing the flow of ions;

determining the fluid flow rate by measuring either one or both of:

an ion current density between the first and second electrode arrangements, and;

a relative displacement of the first and second electrode arrangement.

19. A method as claimed in claim 18, wherein:

the step of providing an electric current supply includes supplying an electric current regulated by a micro-controller within the electric circuit, and:

the step of measuring an ion current density includes detecting a current sense signal, corresponding to the ion current density, in a current return path of the micro-controller within the electric circuit.

20. A method as claimed in claim 19, further including the step of activating a standby mode including the steps of:

determining a no fluid flow condition by adapting an operational amplifier circuit in the current return path of the micro-controller to detect a no fluid flow current threshold level selected to be nominally greater than the galvanic current drawn by the electrolytic cell when there is no fluid flow in the body;

providing an output signal of the operational amplifier circuit to the micro-controller;

upon receiving an output signal of the operational amplifier circuit indicating the no fluid flow condition, incrementing a timer within the micro-controller for a predetermined continuous period of time at the end of which, if the no fluid flow condition remains, the micro-controller activates the standby mode by activating circuit shunt means to reduce the electric current supplied to the first and second electrode arrangements.

21. A method as claimed in claim 20, further including the step of activating an operating mode including the steps of:

determining a fluid flow condition by adapting the operational amplifier circuit to detect a fluid flow current threshold level selected to be nominally greater than the no fluid flow current threshold;

periodically sampling the output of the operational amplifier circuit at the micro-controller during the standby mode;

upon receiving an output signal of the operational amplifier circuit indicating the fluid flow condition, the micro-controller deactivates the circuit shunt means to resume the electric current supplied to the first and second electrode arrangements.

22. A method as claimed in any one of claims 11 to 17 or, 18 to 21 further including the step of:

providing a display to indicate the activation of the standby mode and/or the activation of the operating mode.

23. A method substantially as herein described with reference to at least one of the accompanying drawings.

24. An apparatus substantially as herein described with reference to at least one of the accompanying drawings.

DATED this 24th day of February 2003
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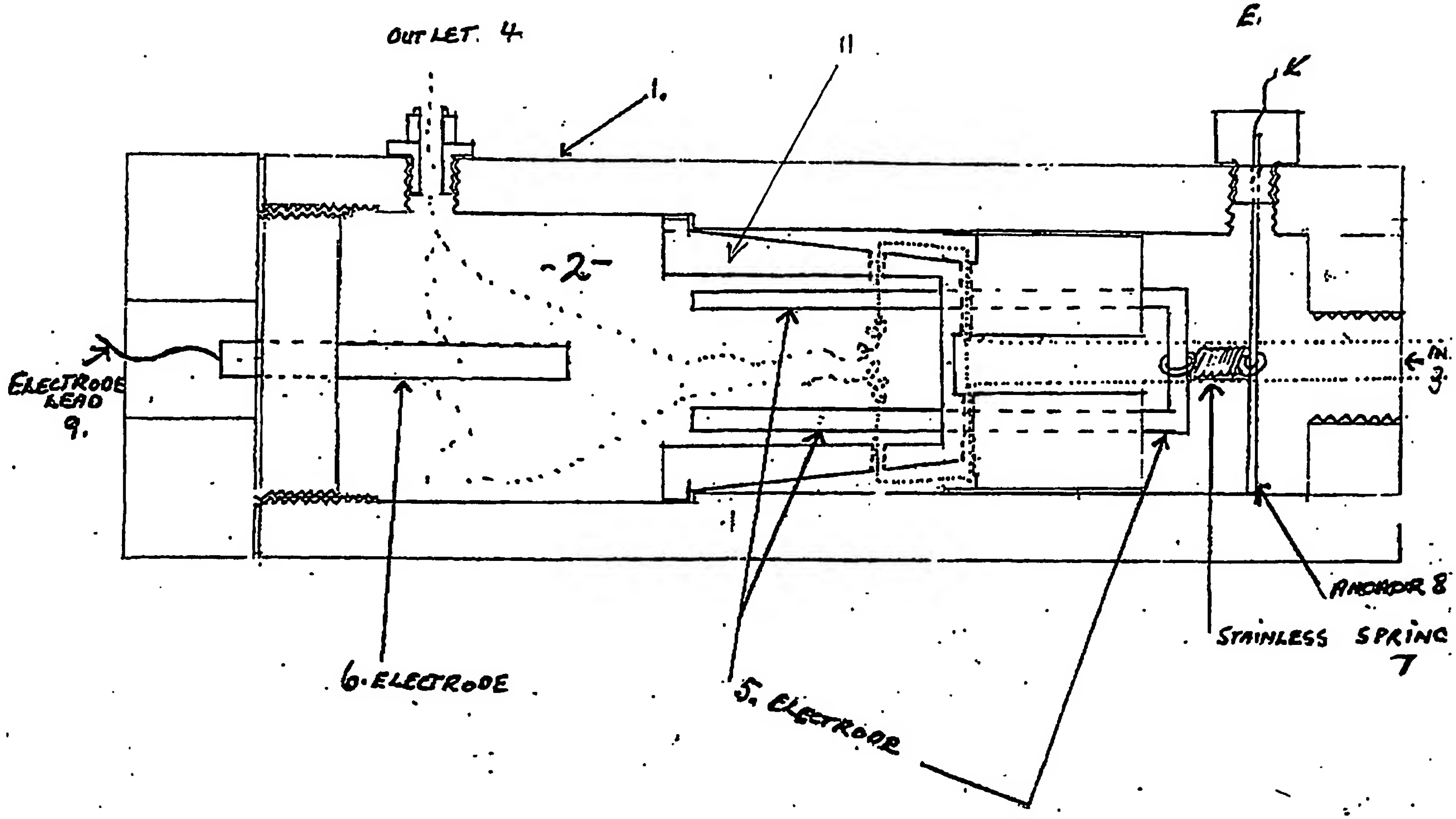
Fig 1.


OUTLET 4
1.
11
E.
K
-2-
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3
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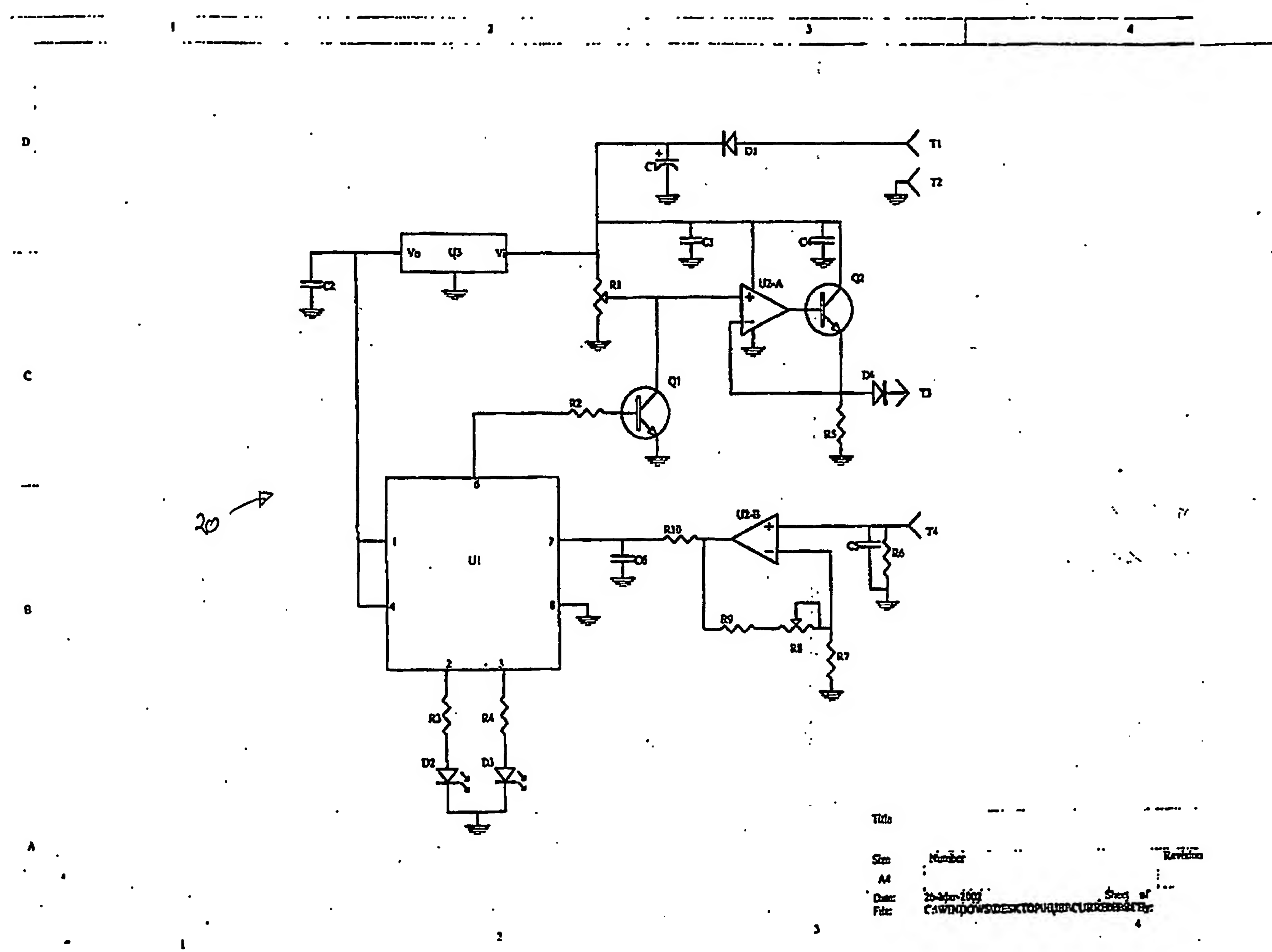
ANCHOR 8
STAINLESS SPRING
7
6. ELECTRODE
5. ELECTRODE

FIG2.



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R6
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R8
R9
R10
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